

PIER Buildings Energy End-use Program - Draft list of potential new research topics. (Not presented in priority order)

Building Category	Project Area	Sub-Areas	Issues and Comments
Commercial, Residential	Innovative Building Envelope Solutions	Integrated design standards (e.g., cool exteriors, passive solar, overhangs, siding, orientation)	Applies to both new and (perhaps especially) existing homes
		Sustainable design materials and life cycle energy of buildings - Standard methodology for determining their energy benefit.	
		Defect resistant systems in new construction (e.g., foolproof construction methods)	
		Test and remediation systems for envelope methodology (e.g., how to go into an existing building and assess the major problems)	Integrated Design Standards is a mature area; problem is market adoption. Maybe need software tools to do this.
		Thermal mass (external versus internal) and LCC and GHG impacts of thermal mass wall considering that concrete is carbon intensive. Also, what is the energy savings of thermal mass wall (as opposed to peak savings which are easier to understand)?	Over its lifetime, buildings "use" as much as 20X the initial embodied energy of the building materials. Need a rigorous study on this, looking at wall systems and not just individual building materials.
		Daylighting versus high insulation value of the envelope	
		Low-cost retrofits (e.g., think about the window as a replaceable product instead of a permanent one). Typically retrofits are prohibitively expensive	
		Lower cost high performance windows and doors	
		Affordable building envelopes and encouraging adoption by the builder.	
		Design-with-climate design guidelines	How to get the industry to look at building orientation, daylighting, thermal mass, and natural ventilation first, THEN add in technology
Commercial, Residential	Low Energy Cooling Systems	Integrated design to reduce AC load	The industry doesn't use the ASHRAE handbook for building design. Why not, and how can PIER address this problem?
		Hybrid conventional (Freus, evaporative condensing unit, appropriate evaporative.)	There are many projects already in this area. Are there new opportunities for research?
		Appropriate evaporative cooling	
		Low-cost cooling device and systems for low-income households	Simple room fans have been shown to increase incidences of heat stroke. Need an alternative for low income families.
		Efficient design and operation of conventional AC (need best practices for using ZEH models)	
Residential	Consumer behavior and energy use feedback strategies	Field study of best energy use feedback technologies. Some study attributes: Appropriate control groups, review of optimum displays, development of functional requirements for effective feedback devices.	There's a need for a large scale study that definitively shows the behavioral change resulting from energy feedback devices placed prominently in the home.
		A study that looks at behavior or what technologies are out there; could be a combination of both.	Must partner with utilities (e.g. SMUD prepaid program data)
		Meter reading devices in the home to see how they affect consumer behavior	Appropriate role for public sector
			Accessible technologies that the average person can use, while providing extensible capabilities for detailed data for advanced users
Commercial, Residential, Appl. & Plug Loads	Enabling technologies for "smart buildings"	Pre-wiring or advanced wiring technologies that can provide extensible capabilities for future energy efficiency upgrades	For DC power supply- how much savings potential from DC if conversion efficiency is high? Even if it's only a 3% gain, its from a big chunk of the pie (lighting is 12%, electronics 5%)
		Plumbing	For PV and some loads (e.g. lighting), but not all.
		DC power supply- Assessment of potential, electrical distribution system of the future	New construction opportunities
		For homes with PV systems, see if the DC standard can be applied to home use (e.g., PVs, entertainment, lighting, plug-in hybrid vehicles).	What is involved with growing the infrastructure around DC?
		Enabling technologies for homeowner to recognize Time of Use (TOU) or real-time	
Commercial, Residential	Lighting technologies and controls	Data collection, understanding market issues	Although AB 1109 is not yet passed, there is a lot of lobbying for it.
		Standardized lumen depreciation testing (e.g., for CFLs because many don't perform up to the way they are advertised)	It's a big pie slice, so go for a reasonable share of the RFP
		Daylighting	DOE is doing some lighting standards and proposing rule-making
			Could the CPUC devote some of their efficiency funding to testing of daylighting equipment?

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			Could work with utilities (e.g., SMUD) because it's a market transformation issue.
Appl. & Plug Loads	Consumer and office electronics	Standby, plug-load power	Circuits in the home are different from the office. Perform office plug load research first
		Simple, low cost systems to help people group appliances in categorized circuits, opening DR opportunities	
		DR prepay programs and incentives (e.g., end-users receive a small incentive for using a DR tool that responds to grid emergencies.)	
		Time of Use (TOU) rates and Smart Home synergies	Most of these products are currently available in high-end homes, but they are highly customized and expensive. Affordable products are needed.
Commercial	Diagnostics and Communication Tools	AC diagnostics	What else is needed in HVAC FDD - PIER has done lots of work in this area already?
		Lighting Communications	
		Data standards for diagnostics	
		Manufacturing integration	
		Quality installation	
		Supermarket and industrial refrigeration	
Commercial, Residential	Understanding current building performance	LEED buildings	How much energy does going LEED actually save?
		Title 24 compliance (actual field performance)	
Commercial, Residential	Efficient space and water heating	Commercial hot water systems- most work so far has been in residential. Not much on commercial recirculation systems in hotels, hospitals, etc. Is there a more efficient way to do water heating and distribution in large commercial?	Some current work in multi-family may be relevant
Commercial, Residential	Water use efficiency	Xeriscaping	On site end-use water savings becoming much more important every day.
		Grey water recovery - systems exist (e.g. Aquarecycle)	Work needed to better understand the buildings related end-use opportunities. (This effort should not include work on the embedded energy of treatment and distribution, which is within the PIER Industrial, Agriculture and Water Program's area)
		Other water-saving fixtures (especially hot water)	
Residential	Market Research on High Efficiency & Solar Home Sales Potential	Explore potential links between high efficiency and quicker sales (compare cost of vacant inventory to cost of efficient installations). Provide appropriate outreach of results to building industry.	Start with an analysis of what's already been done. There is an NREL and/o SMUD study out there on this topic.
		Pull together data from different developments and explore the sales data of new energy efficient homes	Not just solar, but also high efficiency without solar. Go through existing data. Builders are afraid to do it, despite anecdotal evidence that solar homes are selling twice as fast
		Understanding behavior topic (both consumer and builder issue). Need to know what motivates people.	
		Intervening in the appraisal process.	Always do efficiency first, then solar. There was a modest positive ROI for PV but far lower than efficiency. PV is what sells the efficiency. New Solar Partnership requires the efficiency measures.
			The cost of making a new home PV ready is miniscule
			It will be a null issue when you talk about sales potential, unless it's included in the appraisal process
Commercial, Residential	Opportunities within specific sectors	Hospitals (planned)	
		Mobile homes	
		Prisons and correctional facilities	
	Demand Response	Smart appliances and controls	Utility integration with DR (i.e., are you saving energy or costing energy?)

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Appl. & Plug Loads	Demand Response Technologies	Load shed priorities and predictive load shed	PIER Crosscutting is doing this but there may be a role for PIER Buildings on the customer side.
		Innovative Thermal Energy Storage (TES) opportunities (i.e., structured pre-cooling,	
Appl. & Plug Loads	Efficient Appliances (beyond Energy Star)	Next generation appliances (e.g., TV, dishwasher)	Can we go beyond energy star appliances (which are only 10-20% beyond minimum)?
		Research to inform the national standard or to uncover the potential to inform the national standard	You can't change the DOE test method, but utilities could use a different test method to develop their incentives
		Develop standards that are stricter than Title 20	
		Develop standards for equipment not regulated by the federal gov't (e.g., electrical energy of furnace fan).	
		Understand the impact of federal preemptions on California if we were to develop our own standards	
		Plasma/LCD TV is an issue- switchover to HD may be an opportunity. Consider model of partnering with TV mfrs. as was done with PC mfrs.	
Commercial, Residential	Whole Building Systems for Mixed Use Projects	Modeling tools or devices for Mixed-Use Buildings and Communities	We've learned stuff from single and multifamily
		Design guidelines for mixed use projects (district heating/cooling, community thermal storage, integration of solar/wind, DR, cogeneration)	There are many design guidelines available to the market, but none are targeting the mixed use concept.
			Each mixed-use building is a prototype because it's different.
			Opportunity to engage/collaborate with other PIER program areas (e.g. Renewables)
Commercial, Residential	Alternative Business Models	Shared savings models for multi-tenant properties	Reach out to Architecture 2030 and utilities
		Green leases	Issue of mixed incentives; the person who buys the equipment isn't the one who pays the bill. Is this a standards thing?
			On leases, saving energy bills reduces revenues, so makes them look poor because their profit is based from revenues (not profit)
Commercial, Residential	Thermal and visual comfort models	Better models for standard design, support for low energy cooling.	Lessees and developers who quickly flip buildings mean that mandatory standards are necessary
Commercial, Residential, Appl. & Plug Loads	Commercial / Residential Cooking Equipment	Gas and electric topics	ASHRAE standards are obsolete
		Burner efficiency	PIER is doing a scoping study with PG&E to look at burner efficiency (PIER is still waiting)
		Ventilation	How can advances in digital technology and communication be used in new and innovative ways to provide benefits beyond conceived energy savings?
Commercial, Residential, Appl. & Plug Loads	Combined Heat & Power (CHP) / Combined Cooling Heat & Power (CCHP)	Micro-CHP products and opportunities	
			What is the role of PIER Buildings?
			Collaboration with Utilities
Commercial, Residential	Space Heating	Greenhouse emissions associated with on-site fuel technologies versus all electric buildings	
Commercial, Residential	Pool and hot-tub efficiency	Technology development of advanced solar pool heating	Need to go beyond Title 24 Standards; it's a lot of peak demand.
		Research that could lead to the development of new standards (Title 20)	Hot tubs and pool pumps are not regulated now, but utilities offer incentive programs
		Technology development - efficient recirculation pump	Pool (pumps and filter) consume nearly 1/3 of household energy in homes that have these features
			Residential pools and hot tubs are separate with respect to research